

A CLADISTIC ANALYSIS OF *PROTODICTYA* MALLOCH
(DIPTERA, SCIOMYZIDAE)

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Abstract.—A cladistic analysis of the Neotropical genus *Protopdictya* Malloch, 1993 was done using HENNIG 86. The genus *Dictyodes* Malloch, 1933 was used as the outgroup. The monophyly of *Protopdictya* is supported by the medio-apical process of the fifth sternite of the male. Resulting from this analysis *Protopdictya* is divided into two main clades. The first monophyletic clade includes *P. chilensis* Malloch, 1933 and *P. guttularis* (Wiedemann 1830). The second clade consists of *P. lilloana* Steyskal, 1953, *P. apicalis* Steyskal, 1950, *P. iguassu* Steyskal, 1950, *P. nubilipennis* (Wulp 1897), *P. brasiliensis* (Schiner 1868), and *P. bidentata* (Marinoni and Knutson 1992).

Key Words: *Protopdictya*, snail-killing flies, phylogeny, Neotropical

This study results from a revision of *Protopdictya* Malloch (Marinoni and Knutson 1992), a Neotropical genus of snail-killing flies (Sciomyzidae) with eight species that collectively range from Mexico to southern Argentina. The objective of this paper is to present a phylogenetic analysis of the included species and a discussion of the evidence for a natural classification of the species *sensu* Wiley (1981).

METHODS

The cladistic analysis was performed with the computer program Hennig86 (Farris 1988) using the option "implicit enumeration" (ie). The ordination and polarization of the characters were done in accordance with standard procedures for cladistic analysis (Wiley 1981). At the first analysis the characters were treated as unordered. A matrix of 21 characters and nine taxa were used in the analysis (Table 1). Autapomorphies

for the species were not included in this matrix.

The genus *Dictyodes* Malloch (1933) was selected as the outgroup for the following reasons: 1. A cladistic analysis being developed by the first author of 44 genera of Sciomyzidae *sensu* Griffiths (1972) indicates that *Dictyodes* is the sister group of *Protopdictya*. 2. Abercrombie (1970) stated that the eggs of *Protopdictya* and *Dictyodes* are very similar. 3. Abercrombie (1970) also found that larvae of these two genera are both aquatic predators, suggesting a close relationship between them. 4. *Dictyodes* has morphological characters that are similar and consequently comparable to those of *Protopdictya* (Marinoni and Knutson 1992, Abercrombie and Berg 1978). 5. These two genera have traditionally been assigned to the same taxonomic group (Steyskal and Knutson 1975, Knutson et al. 1976). 6. Both genera occur in the Neotropics (Knutson et al. 1976, Marinoni and Knutson 1992).

Table 1. Matrix of 21 characters and nine taxa with *Dictyodes* as outgroup.

Characters	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	2	1
	0								0	0								0	0	
Species																				
<i>P. chilensis</i>	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	1	0	0	0	0
<i>P. guttularis</i>	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0
<i>P. lilloana</i>	2	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0
<i>P. iguassu</i>	1	1	1	1	1	2	1	1	1	0	1	1	1	1	1	0	1	1	2	2
<i>P. apicalis</i>	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1	1
<i>P. nubilipennis</i>	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1
<i>P. brasiliensis</i>	1	1	1	1	1	1	1	1	?	?	1	1	1	1	1	0	1	1	2	2
<i>P. bidentata</i>	1	1	1	1	1	0	1	1	?	?	1	1	1	1	1	0	1	1	1	1
<i>D. dictyodes</i>	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	0	1

The characters 9 and 10 for *P. bidentata* and *P. brasiliensis* were coded as missing because females for these species are unknown.

The character 21 was coded as missing for *Dictyodes* because of the absence of the hypandrial process in it.

CHARACTERS AND CHARACTERS STATES
USED IN THE ANALYSIS

The characters discussed in the next section have the same numbering as in the character matrix.

- Character 01. Length of second aristal segment: (0) twice as long as wide; (1) three or more times as long as wide; (2) less than twice as long as wide.
- Character 02. Shape of face in profile: (0) strongly concave; (1) gently concave.
- Character 03. Cell r2+3. (0) without pale spots; (1) with pale spots.
- Character 04. Vestiture of the male syntergosternite: (0) with setae; (1) without setae.
- Character 05. Size of the humeral seta: (0) smaller than the notopleural seta; (1) subequal in size to the notopleural seta.
- Character 06. Size of the ocellar seta: (0) about half the length of the postocellar seta; (1) similar in length to the postocellar seta; (2) about one-third the length of the postocellar seta.
- Character 07. Presutural seta: (0) absent or

- vestigial; (1) present and subequal in size to the notopleural seta.
- Character 08. Medio-apical process of the fifth sternite of the male: (0) absent; (1) present.
- Character 09. Shape of the spermathecae (Fig. 2): (0) spherical or nearly so; (1) with the top and bottom flat to concave; (?) non-comparable.
- Character 10. Anterior spermathecae projection (Fig. 2): (0) vestigial; (1) absent; (2) well developed.
- Character 11. Facial black spot: (0) absent; (1) present.
- Character 12. Posterior seta of the head: (0) well developed; not so developed.
- Character 13. Number of dorsocentral setae: (0) 4; (1) 2.
- Character 14. Prominent eyes: (0) absent; (1) present.
- Character 15. Subvibrissal setae: (0) absent; (1) present.
- Character 16. Arista: (0) plumose; (1) not plumose.
- Character 17. Lunula: (0) vestigial; (1) present but poorly developed; (2) well developed.
- Character 18. Process between the eyes: (0) vestigial; (1) present but poorly developed; (2) well developed.
- Character 19. Shape of anterior extremity of the paramere (Fig. 1): (0) rounded; (1) pointed; (2) not so pointed.

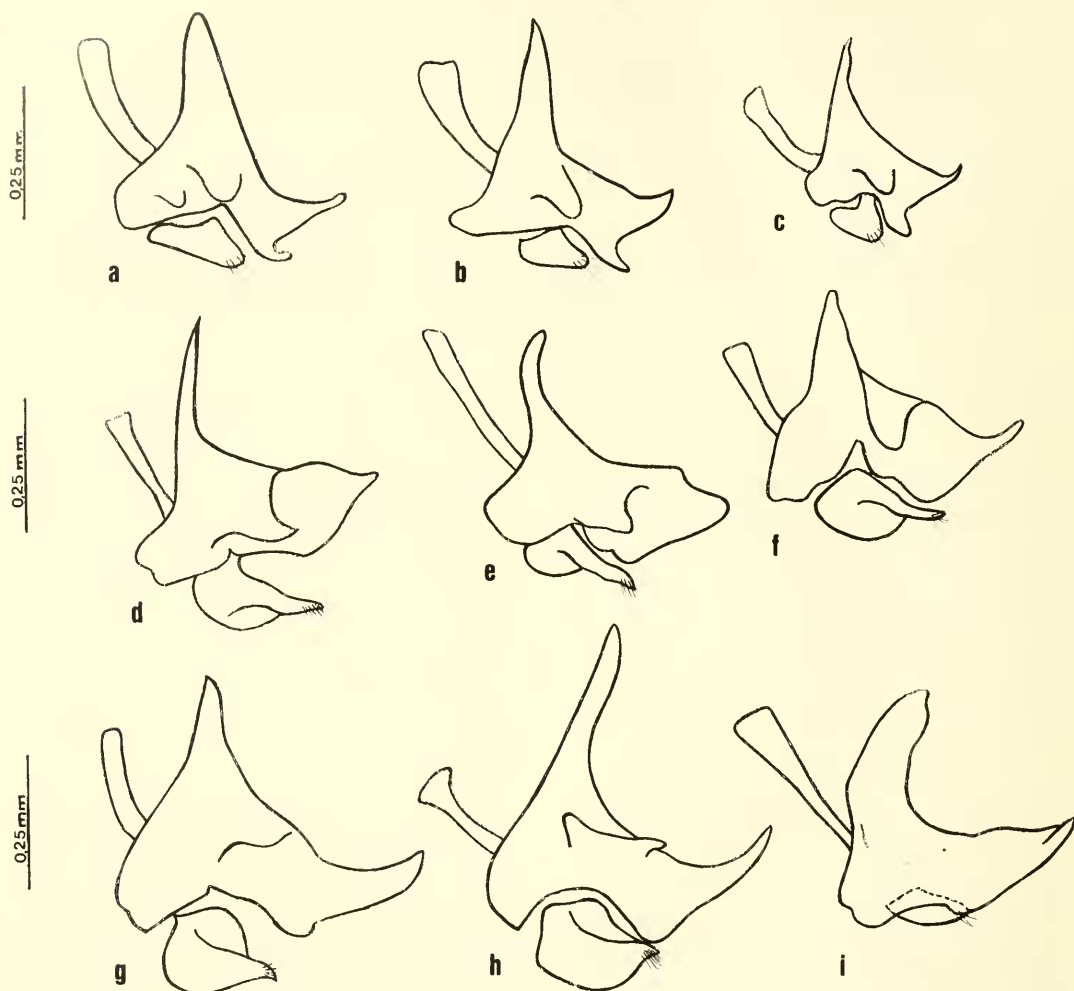


Fig. 1. Male terminalia shown laterally with aedeagus removed: a. *P. chilensis*, b. *P. guttularis*, c. *P. lilloana*, d. *P. apicalis*, e. *P. bidentata*, f. *P. nubilipennis*, g. *P. iguassu*, h. *P. brasiliensis*, i. *Dictyodes dictyodes*.

Character 20. Ventral surface of the gonopod (Fig. 1): (0) very sinuous; (1) sinuous, almost straight; (2) slightly sinuous.

Character 21. Hypandrial process (Fig. 1): (0) with the extremity pointed; (1) with the extremity rounded (finger-like); (2) almost straight, not finger-like.

RESULTS

The cladistic analysis resulted in a single, most-parsimonious cladogram with a length of 30 steps and a consistency index of 0.96.

Two primary clades were formed at the base. The first clade consists of *P. chilensis* + *P. guttularis* and the second of *P. lilloana*, *P. apicalis*, *P. nubilipennis*, *P. iguassu*, *P. brasiliensis* and *P. bidentata*. The relationships among the species of the second clade were not well resolved, largely because females of *P. brasiliensis* and *P. bidentata* are unknown, and some character states for these species were coded as missing.

Steyskal (1950) defined two species groups using an intuitive method of analysis. *Protodictya chilensis*, *P. lilloana* and *P. guttu-*

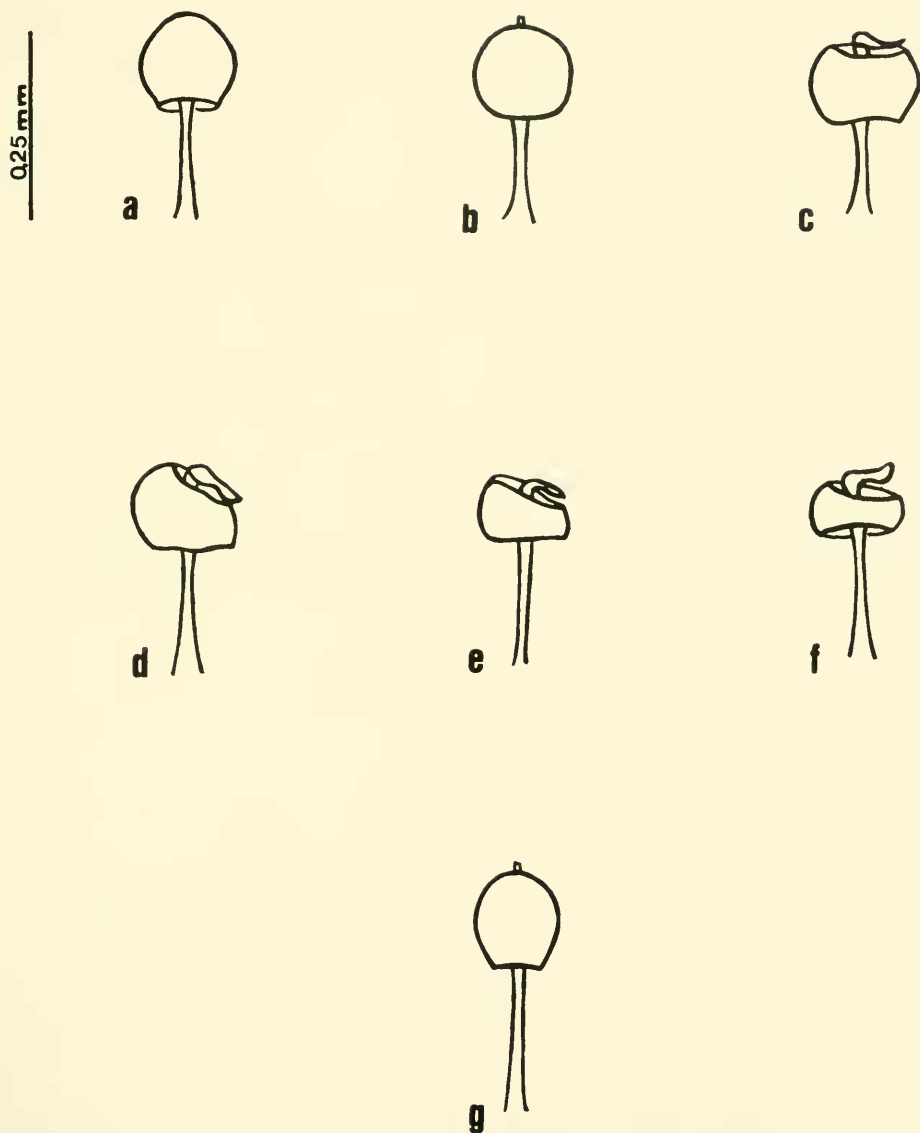


Fig. 2. Spermathecae of: a. *P. chilensis*, b. *P. guttularis*, c. *P. lilloana*, d. *P. apicalis*, e. *P. nubilipennis*, f. *P. iguassu*, g. *Dictyodes dictyodes*.

laris were placed in one group and *P. apicalis*, *P. iguassu*, *P. brasiliensis* and *P. nubilipennis* in another one. His groups are concordant in part with the monophyletic groups defined above.

Abercrombie (1970) presented the natural histories of the life stages of some Neotropical Sciomyzidae, including those of *P. chilensis*, *P. guttularis*, *P. lilloana* and *P.*

apicalis. This author compared his results on *P. apicalis* with those of *P. hondurana* (= *P. nubilipennis*) presented by Neff and Berg (1961) and concluded that the larvae of both genera have similar behaviors. This evidence supports the presence of *P. apicalis* and *P. nubilipennis* in the same group of species. The larvae of both genera tolerate putrescent conditions and willingly feed on

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